fabricating a graded composition buffer including a plurality of epitaxial semiconductor $In_x(Al_yGa_{1-y})_{1-x}P$ alloy layers, said buffer comprising a first alloy layer immediately contacting the substrate having a lattice constant that is nearly identical to that of the substrate, subsequent alloy layers having lattice constants that differ from adjacent layers by less than 1%, and a final alloy layer having a lattice constant that is substantially different from the substrate, wherein growth temperature of the final alloy layer is at least 20°C less than the growth temperature of the first alloy layer, said graded composition buffer is grown using a vapor-phase epitaxy technique.

B3 end

REMARKS

Claims 31 and 32 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of the previous claims. Applicants have amended claims 31 and 32 to address the Examiner's concerns.

Claims 1, 2, and 34 are rejected under 35 USC §102(b) as being anticipated by the paper written by Chin et al.

Independent claim 1 recites a method of forming a semiconductor. The method includes providing a single crystal semiconductor substrate of GaP. The method also includes fabricating a graded composition buffer including a plurality of epitaxial semiconductor $In_x(Al_yGa_{1-y})_{1-x}.P$ alloys layers. The buffer comprises a first alloy layer immediately contacting the substrate having a lattice constant that is nearly identical to that of the substrate and a growth temperature greater than 650°C. There are provided subsequent alloy layers having a

lattice constant that differ from adjacent layers by less than 1%, and a final alloy layer having a lattice constant this essentially substantially different from the substrate, wherein growth temperature of the final alloy layer is at least 20°C less than the growth temperature of the first alloy layer.

Chin et al. describe highly mismatched $In_x(Al_yGa_{1-y})_{1-x}.P$ ($x \leq 0.38$) layers grown on GaP substrates by gas-source molecular beam epitaxy. A relatively thin, compositionally linear-graded buffer layer is used to reduce the number of threading dislocation.

Amended independent claim 1 recites that the growth temperature of the first alloy layer is greater than 650 °C. Chin et al. specifically recite that their growth temperature is less than 650 °C. In particular, Chin et al. describe forming a GaP substrate at 650 °C on a Si substrate followed by a graded $In_xGa_{1-x}P$ buffer. In forming the buffer, the substrate temperature is decreased from 650 °C to a final temperature between 490 and 550 °C. However, the growth temperature of the first alloy layer can be as high as 800 °C, because the invention uses vapor-phase epitaxy as the growth technique. Persons skilled in the art know that the MBE process used by Chin et al. would not yield the same results at high temperatures as claimed. Therefore, Chin et al. does not anticipate claim 1.

As to claims 2 and 34, they are dependent on claim 1, respectively. Therefore, claims 2 and 34 are also allowable for the same reasons argued with respect to claim 1.

Claims 3-33 are rejected under 35 USC §103 as being obvious over Chin et al.

Given that claims 3-22 are dependent on claim 1, the reasons argued for claim 1 are also applicable here. Furthermore, the Examiner asserts that routine experimentation using the

techniques described in Chin et al. could be used to obtain results recited in claims 3-22. As stated above, Chin et al. use a very different technique to form buffers, which limits its ability to use growth temperatures beyond 650°C. A person of skill in the art would require undue experimentation to try to reach the growth temperatures recited in claims 3-22. Therefore, it is requested that the Examiner reconsider his position on claims 3-22.

Claims 23-29 and 36-39 are rejected under 35 USC §103 as being obvious in view of Chin et al. and Chen et al., US 6,064,076.

Chen et al. '076 describes a light-emitting diode having a transparent GaP substrate that includes a first lattice constant, a first ohmic contact to the GaP substrate, a buffer layer having a graded lattice constant which gradually changes from a first lattice constant to a second lattice constant, a light generating region formed on the buffer layer and having the second lattice constant, and a second ohmic contact formed on the light generating region. Light emitted to the substrate is not absorbed by the transparent substrate.

Given that claims 23-29 and 36-39 are dependent on claim 1, the reasons argued for claim 1 are also applicable here. Also, Chen et al. '076 does not address the deficiencies of Chin et al. Therefore, the proposed combination of Chin et al. and Chen et al. '076 does not render obvious claims 23-29 and 36-39.

Claims 30-33 and 40-52 are rejected under 35 USC §103 as being obvious in view of Chin et al. and Chen et al., US 6,064,076.

Given that claims 30-33 and 40-52 are dependent on claim 1, the reasons argued for claim 1 are also applicable here. Also, Chen et al. '076 does not address the deficiencies of

Chin et al. Furthermore, the Examiner asserts that routine experimentation using the techniques described in Chin et al. could be used to obtain results recited in claims 30-33 and 40-52. As stated above, Chin et al. uses a very different technique to form it buffers, which limits its ability to use growth temperatures beyond 650°C. Therefore, the proposed combination of Chin et al. and Chen et al. '076 does not render obvious claims 23-29 and 36-39.

As to claim 55, it is a device claim associated with the method claim 1. Thus, all arguments regarding claim 1 are also associated with claim 55. Furthermore, claim 56 recites using a vapor-phase epitaxy technique to grow graded composition buffers. Neither of the references cited, either alone or in combination, teach or suggest this limitation.

In view of the above amendments and for all the reasons set forth above, the Examiner is respectfully requested to reconsider and withdraw the objection(s), and rejection(s) made under 35 U.S.C. §§ 103 and 112, second paragraph. Accordingly, an early indication of allowability is earnestly solicited.

If the Examiner has any questions regarding matters pending in this application, please feel free to contact the undersigned below.

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Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned **<u>"VERSION WITH MARKINGS TO SHOW CHANGES MADE"</u>**.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Claims 1 and 31-32 have been amended as follows:

1 (Amended). A method of forming a semiconductor structure comprising:

providing a single crystal semiconductor substrate of GaP; and

fabricating a graded composition buffer including a plurality of epitaxial semiconductor $In_x(Al_yGa_{1-y})_{1-x}P$ alloy layers, said buffer comprising a first alloy layer immediately contacting the substrate having a lattice constant that is nearly identical to that of the substrate and a growth temperature greater than 650°C, subsequent alloy layers having lattice constants that differ from adjacent layers by less than 1%, and a final alloy layer having a lattice constant that is substantially different from the substrate, wherein growth temperature of the final alloy layer is at least 20°C less than the growth temperature of the first alloy layer.

31 (Amended). The method claim of claim ~~30~~27, wherein the strain balancing semiconductor layer comprises an epitaxial layer.

32 (Amended). The method claim of claim ~~30~~27, wherein the strain balancing semiconductor layer comprises a wafer-bonded layer.